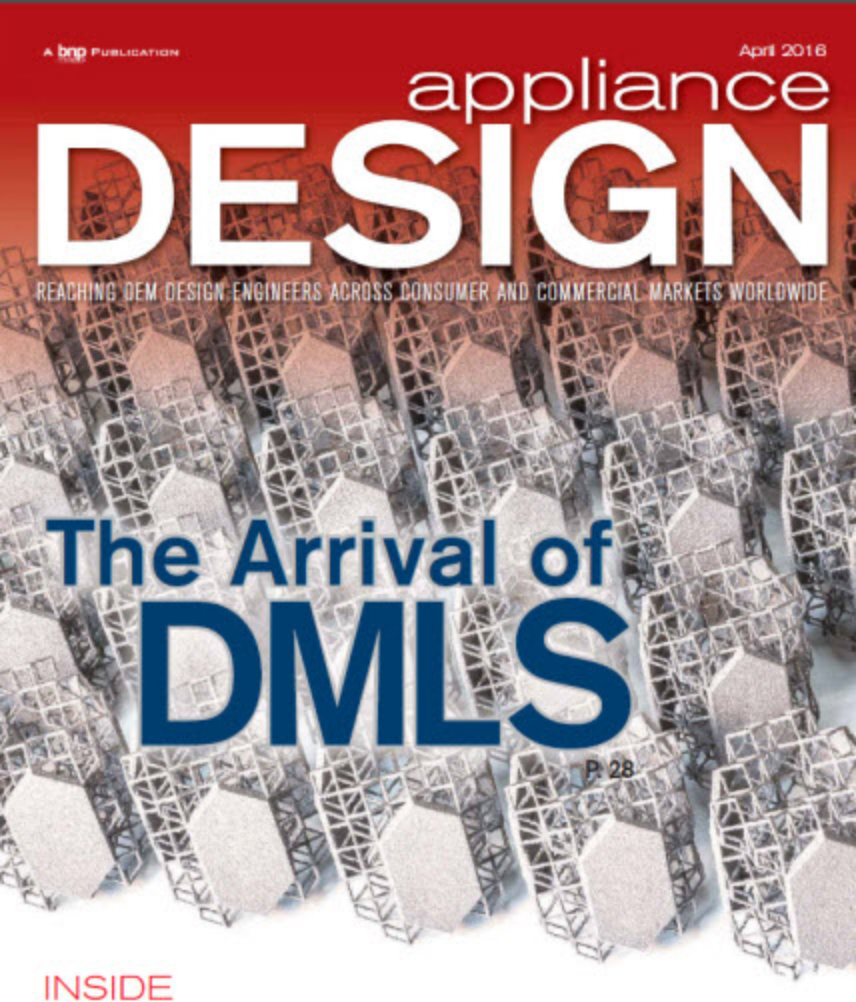
A bnp Publication

April 2016

appliance DESIGN

REACHING OEM DESIGN ENGINEERS ACROSS CONSUMER AND COMMERCIAL MARKETS WORLDWIDE

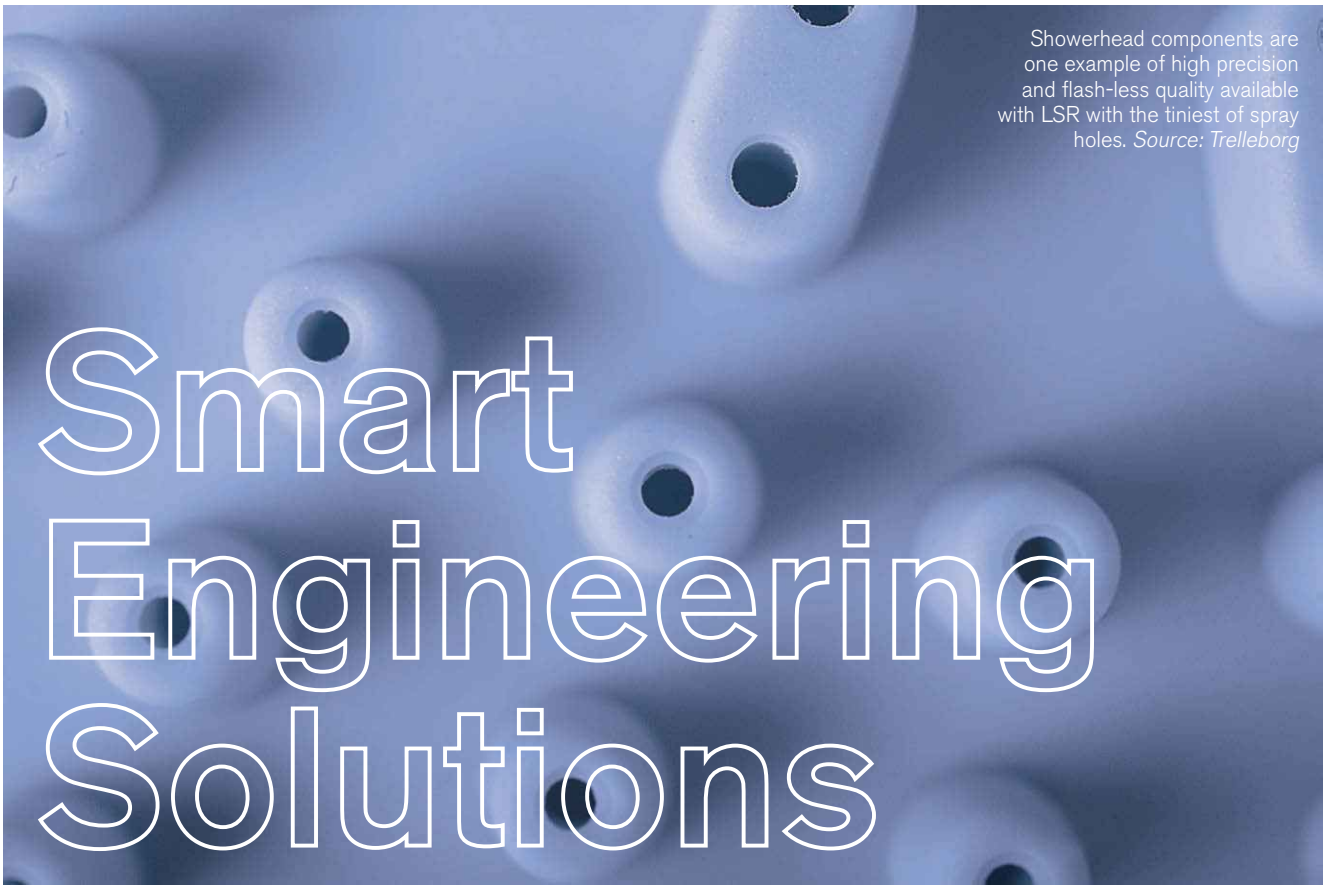


The Arrival of DMLS

P. 28

INSIDE

www.applianceDESIGN.com



Showerhead components are one example of high precision and flash-less quality available with LSR with the tiniest of spray holes. *Source: Trelleborg*

Smart Engineering Solutions

for Smart Appliances with LSR Processing

Learn more about liquid silicone rubber.

by ursula nollenberger

***Ursula Nollenberger** is the product director, LSR components, at Trelleborg Sealing Solutions. For more information, visit tss.trelleborg.com.*

The Research and Markets Institute (researchandmarkets.com) projects the global household appliances industry to reach an estimated value of $324.2 billion by 2019. Amongst the major drivers are growing affluence of the middle-class population in emerging markets, higher disposable incomes, and more per capita spent on lifestyle products in increasingly urbanized environments.

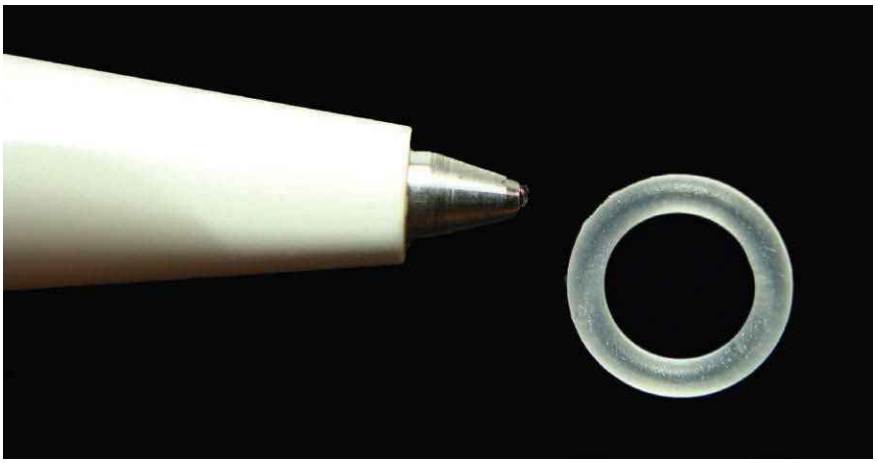
Increasing awareness of energy and natural resources has brought about fresh energy conservation initiatives and efficiency norms that foster the development of newer technology appliances with lower energy or water consumption. According to WaterSense, an EPA Partnership Program, 30% of American homes' indoor water consumption is for toilets, with water consumption per flush as high as six gallons for older installations. The current federal standard is set at 1.6 gallons, with new flush systems achieving flush rates as low as 1.28 gallons.

The steady influx of technologically advanced appliances that deliver innovative, smart features to save the user time and make life more comfortable will spur increased consumer spending. The industry is focusing on the development of smart and autonomous devices with integrated sensors, intelligent electronic controls and programming concepts. Smart appliances are forecast to show strong potential for future growth, especially against the backdrop of escalating electricity costs worldwide.

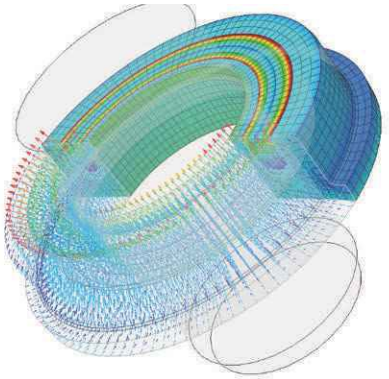
The Trend Points to Greater Usage of LSR

According to a new market research report on the "Smart Homes Market by Product - Trend and Forecast to 2020," the market is expected to grow at a Compound Annual Growth Rate (CAGR) of 17% between 2015 and 2020, and reach $58.68 billion by 2020. Home automation with a view toward the fully connected home is no longer just a vision, it's a reality.

These trends continue to challenge



Flashless LSR Micro O-Ring. This is a direct injection molded example, which is down to 4mm x 1mm in size. *Source: Trelleborg*



Example of a non-linear finite element analysis (NLFEA) component model. *Source: Trelleborg*

appliance and systems designers to come up with new solutions to achieve expected outcomes in terms of basic functionality, technical specifications, service life, ease of use, safety aspects, systems costs, and of course aesthetics. All this is required at an ever increasing speed, to meet the consumers' growing appetite for these new appliance solutions.

Additionally the smart home market is embracing green home solutions such as smart energy management systems that advocate the minimal usage of energy to run appliances. There is increasing awareness among the population about energy efficiency with the caveat of also having security, convenience and comfort.

Appliance engineers are seeking the optimum material and component solutions to meet the challenges of smart appliances and environmentally-friendly equipment. One option is Liquid Silicone Rubber (LSR), which is proving to provide a useful, effective, and smart solution to alleviate fluid management issues or offer innovative sealing, damping or protecting solutions.

The Smart Choice for Appliances

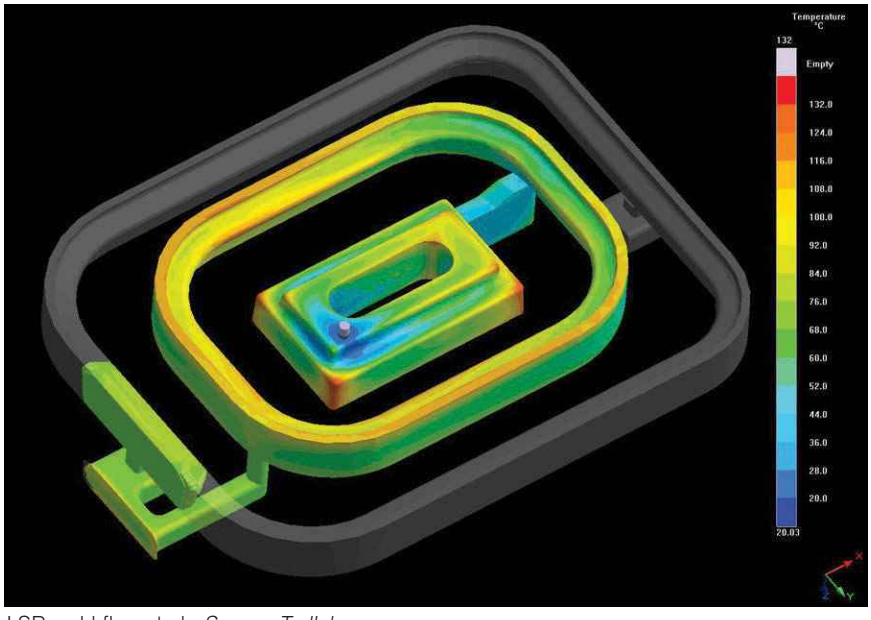
Besides LSR's excellent high-temperature resistance up to +200°C/ +392°F and very good chemical compatibility in a wide range of environments, there are several features that qualify it for use in appliances. For instance, it is neutral in taste, smell and environmentally compatible. It conforms to virtually all global food and fresh water regulations such as FDA, NSF, KTW, WRAS, ACS, BfR. Since the material does not release any gaseous or liquid substances that might interfere with electronics or health, it meets general safety and purity requirements for electronic components. Design engineers also appreciate that it is non-corrosive, non-pyranic, UV resistant, while offering excellent electrical properties.

Key though for appliance and bathroom equipment design engineers is that LSR technology and manufacturing processes can allow the production of extremely complex molded geometries, often combining a number of assembled parts into a single component. The technology also lends itself to micro-molding, in particular the creation of very small through-holes.

Water and Fluid Applications

Showering for the average family adds up to around 40 gallons per day. That's nearly 1.2 trillion gallons of water used in the United States annually just for showering, or to give a different perspective, it is enough to supply the entire water needs of New York and New Jersey for one year. This is in part why innovations in modern designs of shower heads are intended to give the user the best perception of water velocity in the shower, while achieving other objectives, such as lowering water flow rates, enhancing the ease of cleaning and resistance to calcification.

LSR is an effective solution for seals or gaskets in such equipment as faucets and



LSR mold flow study. *Source: Trelleborg*

shower heads to reduce water leaks. LSR solutions can be designed to perfectly match mating components and alleviate excessive water loss. They can adhere to the tightest dimensional tolerances and constraints with high precision, flash-less production. This means LSR can accommodate the molding of the smallest water spray through-holes, both dimensionally, repeatability and flash-free over millions of parts using specialized LSR liquid injection mold tools, sometimes at micro- and Nano-sized injection weights.

Component Design Processes

LSR technology is often focused on integrated design solutions, combining two or more components and materials such as LSR and an engineered plastic into a single fully bonded part. LSR material can be bonded to a multitude of other substrates, in particular plastics and metals. This gives designers much more latitude in design using two principal ways of production, either simultaneous co-injection, also referred as 2K or 2-shot, or by an overmolding technique.

Such solutions can reduce the number of components per system. Creating more robust solutions, they can help to eliminate potential leak paths, remove the risk and cost associated with a secondary assembly, and prevent contamination in dead spaces.

From Concept, Design, Prototype to Serial Production

Leveraging polymer-engineering expertise at the early design stage can accelerate a customer's concept development for smart devices. Innovative processes, such as advanced LSR 2-component technology that combines LSR with technical thermoplastics, can be considered in 3D models. This technique, for instance, offers a wealth of options for integration and miniaturization, resulting in better and more effective solutions in the long run.

In the design phase, engineers can benefit from employing a Non-Linear-Finite-Element-Analysis (NLFEA) tool to model the behavior of components under assembly and application conditions. This improves design under functional criteria before the next stage of producing prototypes, using 3D technology or from a small test tool. From the start of the design of components, a focus on effective manufacturing is key, not just for prototype purposes, but equally for serial production off multi-cavity tools.

Selection of micro-molded LSR components. *Source: Trelleborg*

During the prototype stage, tool and process engineers should collaborate with their suppliers to align critical tool and process concepts. For instance, in the case of LSR injection molded samples from a dedicated Liquid Injection Molding (LIM) tool, the flow of the LSR material into the tool is modeled via a sophisticated flow simulation tool. This confirms such details

Complex components are quite possible with LSR such as this 2-component PA/LSR value produced with an overmolding technique. *Source: Trelleborg*

as the ideal location for, and under what specifications, the material is injected to guarantee the expected outcome. Alterations to the tool construction can be made quickly before the actual tool is machined, thereby accelerating the time for first samples off a first test tool or later on a multi-cavity serial tool.

Everything developed and learned during concept, design and prototyping facilitate all further stages toward small-scale and later large-scale serial production. The development process is accelerated at every stage through collaboration and by working with a supply partner from conception and design to production.

Expect Increased LSR Applications for Smart Appliances

With the influx of new appliances coming on the market, integrated design solutions incorporating LSR are becoming more attractive in terms of combining multiple components into one and/or multiple functions into one. Quality and reliability in performance is something that is continuing to be a priority as appliances become more sophisticated and interconnected.

Final LSR parts are strong and elastic with excellent thermal, chemical and electrical resistance. They maintain their physical properties at extreme temperatures and can withstand sterilization. LSR parts are also biocompatible, so they work well for products in the home. LSR parts will be increasingly used in the form of seals, gaskets, valves and cables in today's appliances.

As appliances become more complex in design and functionality, it will be of even greater important for manufacturers to have supply partners that can support from very first concept stage all the way through to serial production on critical elements, such as polymer moldings, to facilitate a faster product release; not just for individual components but integrated systems solutions. ■